

IN THE CLAIMS

The status of the claims as presently amended is as follows:

1. (Canceled)

2. (Currently Amended) A double feed detecting apparatus ~~comprising: according to claim 1,~~
ultrasonic transmitting means installed on one side of a transport path for a sheet
material for transmitting an ultrasonic wave toward the sheet material;

ultrasonic receiving means installed on the other side of the transport path for the sheet
material for receiving the ultrasonic wave transmitted by said ultrasonic transmitting means and
outputting a received ultrasonic signal;

first double feed determining means for determining whether double feed is arising or not
in accordance with an amplitude of the received ultrasonic signal output by said ultrasonic
receiving means; and

second double feed determining means for determining whether double feed is arising or
not in accordance with a phase of the received ultrasonic signal output by said ultrasonic
receiving means,

wherein said first double feed determining means calculates an amplitude of a noise signal received by said ultrasonic receiving means while said ultrasonic transmitting means does not transmit the ultrasonic wave, and determines whether a double feed is occurring or not on the basis of a change in the ~~calculated~~ amplitude of the received ultrasonic signal and a change in the ~~calculated~~ amplitude of the noise signal.

3. (Currently Amended) A double feed detecting apparatus according to Claim ~~[[1]]~~ 2, further comprising sampling means for foreseeing sampling timing at which the amplitude of the received ultrasonic signal becomes maximum, from a distance from said ultrasonic transmitting means to said ultrasonic receiving means, and a propagation speed of the ultrasonic wave, and for sampling the received ultrasonic signal at the foreseen sampling timing a plurality of times to obtain a plurality of the ~~sampld~~ received ultrasonic signals at the foreseen timing, wherein said first double feed determining means and said second double feed determining means process the received sampld ultrasonic signals ~~after sampled by said sampling means to detect the amplitude and the phase of the received ultrasonic signal.~~

4. (*Currently Amended*) A double feed detecting apparatus according to Claim 2, wherein said first double feed determining means calculates the amplitude of the noise signal immediately before said ultrasonic transmitting means transmits the ultrasonic wave.

5. (*Currently Amended*) A double feed detecting apparatus according to Claim 3, wherein said sampling means ~~executes the sampling of the received ultrasonic signal a plurality of times, and~~ averages data corresponding to the plurality of times of sampling of the received ultrasonic signal by sampling point.

6. (*Currently Amended*) A double feed detecting apparatus ~~according to claim 1, further~~ comprising:

ultrasonic transmitting means installed on one side of a transport path for a sheet material for transmitting an ultrasonic wave toward the sheet material;

ultrasonic receiving means installed on the other side of the transport path for the sheet material for receiving the ultrasonic wave transmitted by said ultrasonic transmitting means and outputting a received ultrasonic signal;

first double feed determining means for determining whether double feed is arising or not in accordance with an amplitude of the received ultrasonic signal output by said ultrasonic receiving means;

second double feed determining means for determining whether double feed is arising or not in accordance with a phase of the received ultrasonic signal output by said ultrasonic receiving means;

phase information obtaining means for obtaining information of a phase of the received ultrasonic signal in a state in which the amplitude of the received ultrasonic signal output by said ultrasonic receiving means becomes maximum; and

basic phase information holding means for holding and storing therein the information of a basic phase ~~information~~ with the phase of the received ultrasonic signal obtained by said phase information obtaining means when said ultrasonic receiving means has directly received the ultrasonic wave transmitted by from said ultrasonic transmitting means ~~as the basic phase,~~

wherein said second double feed determining means compares [[a]] the phase ~~information~~ for comparison which is the phase of the received ultrasonic signal obtained by said phase information obtaining means when said ultrasonic receiving means has received the ultrasonic wave transmitted from said ultrasonic transmitting means ~~the ultrasonic transmitted~~

through the sheet material₁ with the basic phase information held by said basic phase information holding means to thereby determine whether double feed is arising or not.

7. (*Currently Amended*) A double feed detecting apparatus according to Claim 6, wherein said basic phase information holding means renews ~~the information of the basic phase~~ information every ~~each~~ time the sheet material is transported.

8. (*Currently Amended*) A double feed detecting apparatus according to Claim 7, further comprising:

signal amplifying means for amplifying the received ultrasonic signal output by said ultrasonic receiving means at plural kinds of amplification factors; and

information holding timing forming means for forming a timing signal for controlling timing₁ at which said phase information obtaining means obtains the information of the basic phase, on the basis of a change in the amplitude of the received ultrasonic signal after which has been amplified at first amplification factor by in which said signal amplifying means has ~~amplifies the received ultrasonic signal within a range in which it is not~~ the received ultrasonic signal has not been saturated,

wherein said phase information obtaining means obtains ~~the information of the basic phase~~ information from the received ultrasonic signal ~~after which has been amplified at second amplification factor and~~ has been saturated by in which said signal amplifying means has ~~amplified the received ultrasonic signal so as to be saturated, in correspondence with the timing signal, and said second double feed determining means compares the basic phase~~ information and ~~the a phase for comparison of the received ultrasonic signal~~ after amplified at the second amplification factor in which said signal amplifying means has amplified the received ultrasonic signal to thereby effect the determination of double feed.

9. (*Original*) A double feed detecting apparatus according to Claim 8, wherein said signal amplifying means amplifies the received ultrasonic signal at plural kinds of amplification factors by a construction in which a plurality of signal amplifying circuits are series-connected and each connection point is output.

10. (*Original*) A double feed detecting apparatus according to Claim 8, wherein said signal amplifying means amplifies the received ultrasonic signal at plural kinds of amplification factors

by a construction in which signal amplifying circuits of plural kinds of amplification factors are parallel-connected and output is effected from each of the signal amplifying circuits.

11. (*Withdrawn*) A double feed detecting method using a double feed detecting apparatus provided with ultrasonic transmitting means installed on one side of a transport path for a sheet material for transmitting an ultrasonic toward the sheet material, and ultrasonic receiving means installed on the other side of the transport path for the sheet material for receiving said ultrasonic transmitted by said ultrasonic transmitting means and outputting a received ultrasonic signal, said method comprising:

- a first step of calculating an amplitude of the received ultrasonic signal output by said ultrasonic receiving means;

- a second step of calculating an amplitude of a noise signal received by said ultrasonic receiving means while said ultrasonic transmitting means does not transmit the ultrasonic;

- a third step of determining whether double feed or not on the basis of a change in the amplitude of the received ultrasonic signal calculated at said first step, and a change in the amplitude of the noise signal calculated at said second step; and

- a fourth step of detecting a phase change in the received ultrasonic signal to determine whether double feed or not on the basis of the detected phase change.

12. (*Withdrawn*) A computer-readable recording medium having recorded therein a program for a double feed detecting apparatus provided with ultrasonic transmitting means installed on one side of a transport path for a sheet material for transmitting an ultrasonic toward the sheet material, and ultrasonic receiving means installed on the other side of the transport path for the sheet material for receiving the ultrasonic transmitted by said ultrasonic transmitting means and outputting a received ultrasonic signal, said recording medium comprising:

- a first step of calculating an amplitude of the received ultrasonic signal output by said ultrasonic receiving means;

- a second step of calculating an amplitude of a noise signal received by said ultrasonic receiving means while said ultrasonic transmitting means does not transmit the ultrasonic;

- a third step of determining whether double feed or not on the basis of a change in the amplitude of the received ultrasonic signal calculated at said first step, and a change in the amplitude of the noise signal calculated at said second step; and

a fourth step of detecting a phase change in the received ultrasonic signal to determine whether double feed or not on the basis of the detected phase change.

13. (*Currently Amended*) A double feed detecting apparatus comprising:

ultrasonic transmitting means installed on one side of a transport path for a sheet material for transmitting an ultrasonic wave toward the sheet material;

ultrasonic receiving means installed on the other side of the transport path for the sheet material for receiving said ultrasonic wave and outputting a received ultrasonic signal;

control means for ~~controlling~~ adjusting an amplitude of the received ultrasonic signal of said ultrasonic receiving means to a prescribed value, by altering at least one of an obtaining timing of the received ultrasonic signal ~~[[and/]]~~ or a characteristic of the ultrasonic wave transmitted by said ultrasonic transmitting means ~~to adjust an amplitude of the received ultrasonic signal output by said ultrasonic receiving means;~~ and

signal analyzing means for analyzing whether a double feed is occurring or not on the basis of a change in the amplitude of the received ultrasonic signal output by said ultrasonic receiving means which has been adjusted by said control means.

14. (*Currently Amended*) A double feed detecting apparatus according to Claim 13, wherein the ultrasonic wave transmitted by said ultrasonic transmitting means is an ultrasonic burst-wave, and the characteristic of the ultrasonic wave transmitted by said ultrasonic transmitting means which is controlled by said control means is a pulse number in the ultrasonic burst-wave ~~of the ultrasonic~~.

15. (*Currently Amended*) A double feed detecting apparatus according to Claim 13, wherein the characteristic of the ultrasonic wave transmitted by said ultrasonic transmitting means which is controlled by said control means is a pulse amplitude of the ultrasonic wave.

16. (*Currently Amended*) A double feed detecting apparatus according to Claim 13, wherein the characteristic of the ultrasonic wave transmitted by said ultrasonic transmitting means which is controlled by said control means is a frequency of the ultrasonic wave.

17. (*Currently Amended*) A double feed detecting apparatus according to Claim 13, wherein the ultrasonic wave transmitted by said ultrasonic transmitting means is an ultrasonic burst-wave,

and the obtaining timing of the received ultrasonic signal controlled by said control means is timing for obtaining the received ultrasonic signal assuming a desired amplitude by the utilization of the fact that the amplitude of the received ultrasonic signal generated by the ultrasonic burst-wave of the ultrasonic is increased or decreased by the lapse of time.

18. (*Currently Amended*) A double feed detecting apparatus according to Claim 13, wherein the ultrasonic wave transmitted by said ultrasonic transmitting means is an ultrasonic burst-wave, and the characteristic of the ultrasonic wave transmitted by said ultrasonic transmitting means which is controlled by said control means is one or a combination of a pulse number, a pulse amplitude and a frequency in the ultrasonic burst-wave of the ultrasonic, and the obtaining timing of the received ultrasonic signal controlled by said control means is a timing for obtaining the received ultrasonic signal assuming a desired amplitude by the utilization of the fact that the amplitude of the received ultrasonic signal generated by the ultrasonic burst-wave of the ultrasonic is increased or decreased by the lapse of time.

19. (*Original*) A double feed detecting apparatus according to Claim 13, wherein when a plurality of the sheet materials are being continuously transported at a predetermined interval, said control means performs control for adjusting the amplitude of the received ultrasonic signal before each sheet material passes between said ultrasonic transmitting means and said ultrasonic receiving means.

20. (*Currently Amended*) A double feed detecting apparatus comprising:

ultrasonic transmitting means installed on one side of a transport path for a sheet material for transmitting an ultrasonic ~~of a~~ burst-wave toward the sheet material at an arbitrary time interval;

ultrasonic receiving means installed on the other side of the transport path for the sheet material for receiving the ultrasonic burst-wave transmitted by said ultrasonic transmitting means and outputting a received ultrasonic signal;

signal analyzing means for analyzing ~~whether double feed or not and a change in a~~ convergence time that is required for convergence of the received ultrasonic signal output by said ultrasonic receiving means ~~to be converged~~, analyzing a change in the convergence time, and analyzing whether a double feed is occurring or not on the basis of a change in an amplitude of the received ultrasonic signal output by said ultrasonic receiving means; and

control means for controlling said ultrasonic transmitting means so as to change the time interval at which the ultrasonic burst-wave is transmitted, in accordance with the change in the convergence time analyzed by said signal analyzing means.

21. (*Currently Amended*) A double feed detecting apparatus according to Claim 20, wherein said signal analyzing means obtains a maximum amplitude value ~~during a maximum~~ while monitoring amplitude of the received ultrasonic signal, and calculates the convergence time on the basis of the obtained maximum amplitude value.

22. (*Currently Amended*) A double feed detecting apparatus according to Claim 20, wherein said signal analyzing means utilizes a threshold value of an amplitude for judging the convergence of the received ultrasonic signal to calculate the convergence time ~~from~~ by calculating a time ~~from after the reception start of reception~~ of the received ultrasonic signal ~~is started~~ until the moment at which the amplitude of the received ultrasonic signal becomes equal to or less than the threshold value.

23. (*Withdrawn*) A double feed detecting method using a double feed detecting apparatus provided with ultrasonic transmitting means installed on one side of a transport path for a sheet material for transmitting an ultrasonic toward the sheet material, and ultrasonic receiving means installed on the other side of the transport path for the sheet material for receiving the ultrasonic transmitted by said ultrasonic transmitting means and outputting a received ultrasonic signal, said method comprising:

a first step of controlling an obtaining timing of the received ultrasonic signal and/or a characteristic of the ultrasonic transmitted by said ultrasonic transmitting means to adjust an amplitude of the received ultrasonic signal output by said ultrasonic receiving means; and

a second step of analyzing whether double feed or not on the basis of a change in the amplitude of the received ultrasonic signal output by said ultrasonic receiving means which has been adjusted by said first step.

24. (*Canceled*)